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(54) Title: SUBSCRIBER IDENTIFICATION SYSTEM

(57) Abstract

A subscriber identification system (100) is presented in which subscriber selection data (250) including channel changes (134), volume changes (132), and time–of–day viewing information is used to identify a subscriber (user) (130) from a group of subscribers (130). In one instance, the subscriber selection data (250) is recorded and a signal processing algorithm such as a fourier transform is used to produce a processed version of the subscriber selection data. The processed version of the subscriber selection data (250) can be correlated with stored common identifiers of subscriber profiles to determine which subscriber (130) from the group is presently viewing the programming. A neural network or fuzzy logic can be used as the mechanism for identifying the subscriber (130) from clusters of information which are associated with individual subscribers.
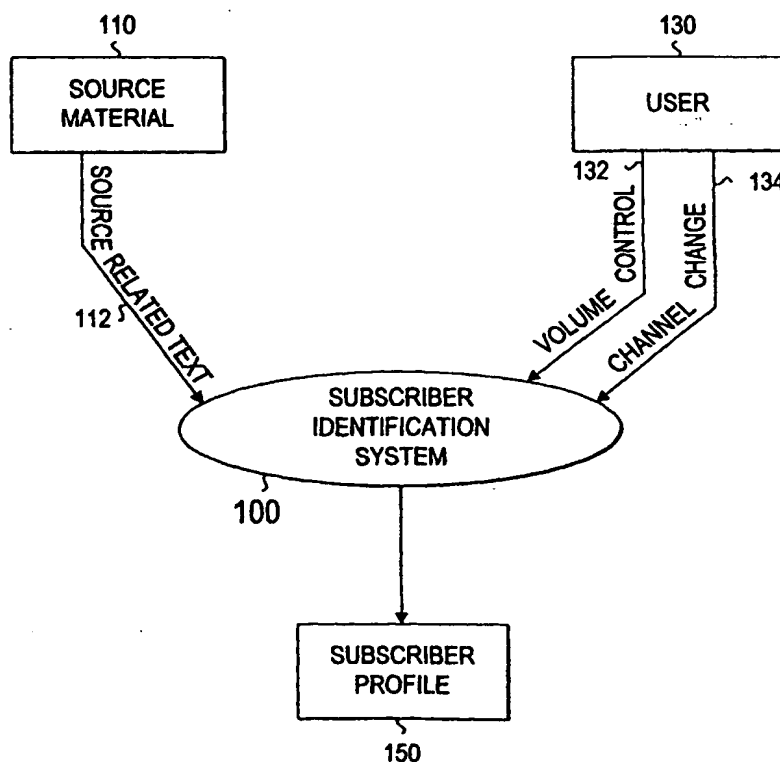
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TITLE

Subscriber Identification System

5   **Background Of The Invention**

The ability to direct specific advertisements to
subscribers of entertainment programming and users of on-
line services is dependent on identifying their product
10   preferences and demographics.   A number of techniques are
being developed to identify subscriber characteristics and
include data mining techniques and collaborative filtering.

Even when subscriber characterizations can be
performed, it is often the case that the television/set-top
15   or personal computer that is receiving the programming is
used by several members of a household. Given that these
members of the household can have very different demographic
characteristics and product preferences, it is important to
be able to identify which subscriber is utilizing the
20   system.   Additionally, it would be useful to be able to
utilize previous characterizations of a subscriber, once
that subscriber is identified from a group of users. Known
prior art for identifying users is based on the use of
browser cookies to identify a PC machine when accessing a
25   Web server. Browser cookies are well used in today's
Internet advertising technology as described in the
following product literature.

The product literature from Aptex software Inc.,
"SelectCast for Ad Servers," printed from the World Wide Web
30   site   http://www.aptex.com/products-selectcast-commerce.htm
on June 30, 1998 discloses the product SelectCast for Ad
Servers. SelectCast for Ad Servers, mines the content of all
users' actions and learns the detailed interests of all
users to deliver a designated ad.   SelectCast allows

advertisers to target audiences based on lifestyle or demography. SelectCast uses browser cookies to identify individuals.

The product literature from Imgis Inc., "AdForce" printed from the World Wide Web site http://www.starpt.com/core/ad_Target.html on june 30, 1998 discloses an ad targeting system. AdForce is a full service end to end Internet advertising management including campaign planning and scheduling, targeting, delivering and tracking results. AdForce uses techniques such as mapping and cookies to identify Web users.

For the foregoing reasons, there is a need for a subscriber identification system which can identify a subscriber in a household or business and retrieve previous characterizations.

Summary Of The Invention

The present invention encompasses a system for identifying a particular subscriber from a household or business.

The present invention encompasses a method and apparatus for identifying a subscriber based on their particular viewing and program selection habits. As a subscriber enters channel change commands in a video or computer system, the sequence of commands entered and programs selected are recorded, along with additional information which can include the volume level at which a program is listened. In a preferred embodiment, this information is used to form a session data vector which can be used by a neural network to identify the subscriber based on recognition of that subscribers traits based on previous sessions.

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In an alternate embodiment, the content that the subscriber is viewing, or text associated with the content, is mined to produce statistical information regarding the programming including the demographics of the target

5 audience and the type of content being viewed. This program related information is also included in the session data vector and is used to identify the subscriber.

In one embodiment, subscriber selection data are processed using a Fourier transform to obtain a signature

10 for each session profile wherein the session profile comprises a probabilistic determination of the subscriber demographic data and the program characteristics. In a preferred embodiment a classification system is used to cluster the session profiles wherein the classification

15 system groups the session profiles having highly correlated signatures and wherein a group of session profiles is associated with a common identifier derived from the signatures.

In a preferred embodiment, the system identifies a

20 subscriber by correlating a processed version of the subscriber selection data with the common identifiers of the subscriber profiles stored in the system.

These and other features and objects of the invention will be more fully understood from the following detailed

25 description of the preferred embodiments which should be read in light of the accompanying drawings.

Brief Description Of The Drawings

The accompanying drawings, which are incorporated

30 in and form a part of the specification, illustrate the embodiments of the present invention and, together with the description serve to explain the principles of the invention.

In the drawings:

3.

FIG. 1 illustrates a context diagram of the subscriber identification system;

FIG. 2 illustrates an entity-relationship for the generation of a session data vector;

5 FIG. 3 shows an example of a session data vector;

FIG. 4 shows, in entity relationship form, the learning process of the neural network;

FIG. 5 illustrates competitive learning;

FIGS. 6A-6G represent a session profile;

10 FIG. 7 represents an entity relationships for classifying the sessions profiles;

FIG. 8 shows examples of fuzzy logic rules;

FIG. 9 shows a flowchart for identifying a subscriber;

FIG. 10 shows a pseudo-code for implementing the

15 identification process of the present invention.

Detailed Description
Of The Preferred Embodiment

20 In describing a preferred embodiment of the invention illustrated in the drawings, specific terminology will be used for the sake of clarity. However, the invention is not intended to be limited to the specific terms so selected, and it is to be understood that each specific term includes

25 all technical equivalents which operate in a similar manner to accomplish a similar purpose.

With reference to the drawings, in general, and FIGS. 1 through 10 in particular, the apparatus of the present invention is disclosed.

30 The present invention is directed at a method and apparatus for determining which subscriber in a household or business is receiving and selecting programming.

FIG.1 shows a context diagram of a subscriber identification system 100. The subscriber identification

4.

system 100 monitors the activity of a user 130 with source material 110, and identifies the user 130 by selecting the appropriate subscriber profile from the set of subscriber profiles 150 stored in the system. The source material 110

5   is the content that a user 130 selects, or text associated with the source material. Source material 110 may be, but is not limited to, a source related text 112 embedded in video or other type of multimedia source material including MPEG source material or HTML files. Such text may derive from

10 electronic program guide or closed captioning.

The activities of the user 130 include channel changes 134 and volume control signals 132. Subscriber identification system 100 monitors channel changes 134 as well as volume control signals activities, and generates

15 session characteristics which describe the program watched during that session. The description of the program being watched during that session includes program characteristics such as program category, sub-category and a content description, as well as describing the target demographic

20 group in terms of age, gender, income and other data.

A session characterization process 200 is described in accordance with FIG. 2. A session data vector 240 which is derived in the session characterization process 200 is presented to a neural network 400, to identify the user 130.

25 Identifying a user 130, in that instance, means determining the subscriber profile 150. The subscriber profile 150 contains probabilistic or deterministic measurements of an individual's characteristics including age, gender, and program and product preferences.

30 As illustrated in FIG.2, a session data vector 240 is generated from the source material 110 and the activities of user 130. In a first step, the activities and the source material 110 are presented to the session characterization process 200. This process determines program characteristics

210, program demographic data 230 and subscriber selection data (SSD) 250.

The program characteristics 210 consist of the program category, subcategory and content description. These

5   characteristics are obtained by applying known methods such as data mining techniques or subscriber characterization techniques based on program content.

The program demographic data 230 describes the demographics of the group at which the program is targeted.

10 The demographic characteristics include age, gender and income but are not necessarily limited to.

The subscriber selection data 250 is obtained from the monitoring system and includes details of what the subscriber has selected including the volume level, the

15 channel changes 134, the program title and the channel ID.

As illustrated in FIG. 2, the output of the session characterization process 200 is presented to a data preparation process 220. The data are processed by data preparation process 220 to generate a session data vector

20 240 with components representing the program characteristics 210, the program demographic data 230 and the subscriber selection data 250.

An example of session data vector is illustrated in FIG. 3. Session data vector 240 in FIG. 3 summarizes the

25 viewing session of an exemplary subscriber. The components of the vector provide a temporal profile of the actions of that subscriber.

FIG.4 illustrates the learning process of a neural network 400 which, in a preferred embodiment, can be used to

30 process session data vectors 240 to identify a subscriber. As illustrated in FIG. 4, N session data vectors 240 are obtained from the data preparation process 220. Each session data vector 240 comprises characteristics specific to the viewer. These characteristics can be contained in any one of

6.

-the vector components. As an example, a particular subscriber may frequently view a particular sit-com, reruns of a sit-com, or another sit-com with similar target demographics. Alternatively, a subscriber may always watch

5   programming at a higher volume than the rest of the members of a household, thus permitting identification of that subscriber by that trait. The time at which a subscriber watches programming may also be similar, so it is possible to identify that subscriber by time-of-day characteristics.

10   By grouping the session data vectors 240 such that all session data vectors with similar characteristics are grouped together, it is possible to identify the household members. As illustrated in FIG. 4, a cluster 430 of session data vectors 240 is formed which represents a particular

15   member of that household.

In a preferred embodiment, a neural network 400 is used to perform the clustering operation. Neural network 400 can be trained to perform the identification of a subscriber based on session data vector 240. In the training session N

20   samples of session data vectors 240 are separately presented to the neural network 400. The neural network 400 recognizes the inputs that have the same features and regroup them in the same cluster 430. During this process, the synaptic weights of the links between nodes is adjusted until the

25   network reaches its steady-state. The learning rule applied can be a competitive learning rule where each neuron represents a particular cluster 430, and is thus "fired" only if the input presents the features represented in that cluster 430. Other learning rules capable of classifying a

30   set of inputs can also be utilized. At the end of this process, M clusters 430 are formed, each representing a subscriber.

. In FIG. 5 an example of competitive single-layer neural network is depicted. Such a neural network can be utilized

.to realize neural network 400. In a preferred embodiment a shaded neuron 500 is "fired" by a pattern. The input vector, in this instance a session data vector 240, is presented to input nodes 510. The input is then recognized as being a
5   member of the cluster 430 associated with the shaded neuron 500.

In one embodiment, the subscriber selection data 250, which include the channel changes and volume control are further processed to obtain a signature. The signature is
10   representative of the interaction between the subscriber and the source material 110. It is well known that subscribers have their own viewing habits which translates into a pattern of selection data specific to each subscriber. The so called "zapping syndrome" illustrates a particular
15   pattern of selection data wherein the subscriber continuously changes channels every 1-2 minutes.

In a preferred embodiment, the signature is the Fourier transform of the signal representing the volume control and channel changes. The volume control and channel changes
20   signal is shown in FIG. 6A, while the signature is illustrated in FIG. 6B. Those skilled in the art will recognize that the volume control and channel changes signal can be represented by a succession of window functions or rectangular pulses, thus by a mathematical expression. The
25   channel changes are represented by a brief transition to the zero level, which is represented in FIG. 6A by the dotted lines.

The discrete spectrum shown in FIG. 6B can be obtained from the Digital Fourier Transform of the volume and channel
30   changes signal. Other methods for obtaining a signature from a signal are well known to those skilled in the art and include wavelet transform.

.In this embodiment of the present invention, the signature is combined with the program demographic data 230

8.

and program characteristics 210 to form a session profile which is identified by the signature signal. The program demographic data 230 and program characteristics 210 are represented in FIGS. 6C through 6G. FIG. 6C represents the

5 probabilistic values of the program category. FIGS. 6D and 6E represent the probabilistic values of the program sub-category and program content, respectively.

The program demographic data 230, which include the probabilistic values of the age and gender of the program

10 recipients are illustrated in FIGS. 6F and 6G respectively.

FIG. 7 illustrates the entity relationship for classifying the session based on the signature signal. In this embodiment, sessions having the same signature are grouped together. Session classification process 700

15 correlates the signature of different session profiles 710 and groups the sessions having highly correlated signatures into the same class 720. Other methods used in pattern classification can also be used to classify the session into classes. In this embodiment, each class 720 is composed by a

20 set of session profiles with a common signature. The set of session profiles within a class can be converted into a subscriber profile by averaging the program characteristics 210 and the program demographic data 230 of the session profiles within the set. For example, the probabilistic

25 values of the program category would be the average of all the probabilistic values of the program category within the set.

In one embodiment, a deterministic representation of the program demographic data 230 can be obtained by use of

30 fuzzy logic rules inside the common profile. Examples of rules that can be applied to the common profile are presented in FIG.8. In this embodiment, the program demographic data are probabilistic values, which describe the likelihood of a subscriber to be part of a demographic

9.

group. As an example, the demographic data can contain a probability of 0.5 of the subscriber being a female and 0.5 of being a male. By use of fuzzy logic rules such as those shown in FIG. 8, these probabilistic values can be combined

5   with the probabilistic values related to program characteristics 210 to infer a crisp value of the gender. Fuzzy logic is generally used to infer a crisp outcome from fuzzy inputs wherein the inputs values can take any possible values within an interval [a,b].

10   The subscriber profile obtained from a set of session profiles within a class is associated with a common identifier which can be derived from the averaging of signatures associated with the session profiles within that class. Other methods for determining a common signature from

15   a set of signatures can also be applied. In this instance, the common identifier is called the common signature.

In an alternate embodiment, the subscriber profile 150 is obtained through a user-system interaction, which can include a learning program, wherein the subscriber is

20   presented a series of questions or a series of viewing segments, and the answers or responses to the viewing segments are recorded to create the subscriber profile 150.

In yet another embodiment, the subscriber profile 150 is obtained from a third source which may be a retailer or

25   other data collector which is able to create a specific demographic profile for the subscriber.

In one embodiment, the subscriber profile 150 is associated with a Fourier transform representation of the predicted viewing habits of that subscriber which is created

30   based on the demographic data and viewing habits associated with users having that demographic profile. As an example, the demonstrated correlation between income and channel change frequency permits the generation of a subscriber profile based on knowledge of a subscriber's income. Using

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this methodology it is possible to create expected viewing habits which form the basis for a common identifier for the subscriber profile 150.

FIG. 9 illustrates a subscriber identification process
5   wherein the subscriber selection data 250 are processed and correlated with stored common identifiers 930 to determine the subscriber most likely to be viewing the programming. As illustrated in FIG. 9, the subscriber selection data 250 are recorded at record SSD step 900. In a preferred embodiment,
10 the subscriber selection data 250 are the combination of channel changes and volume controls. Alternatively, channel changes signal or volume control signal is used as SSD. At process SSD step 910, a signal processing algorithm can be used to process the SSD and obtain a processed version of
15 the SSD. In one embodiment, the signal processing algorithm is based on the use of the Fourier transform. In this embodiment, the Fourier transform represents the frequency components of the SSD and can be used as a subscriber signature. At correlate processed SSD step 920 the processed
20 SSD obtained at process SSD step 910 is correlated with stored common identifiers 930. Stored common identifiers 930 are obtained from the session classification process 700 described in accordance with FIG. 7. The peak correlation value allows determining which subscriber is most likely to
25 be viewing the programming. At identify subscriber step 940, the subscriber producing the subscriber selection data 250 is then identified among a set of subscribers.

In one embodiment, the system can identify the subscriber after 10 minutes of program viewing. In this
30 embodiment, a window function of length 10 minutes is first applied to subscriber selection data 250 prior to processing by the signal processing algorithm. Similarly, in this embodiment, the stored common identifiers 930 are obtained after applying a window function of the same length to the

11.

subscriber selection data 250. The window function can be a rectangular window, or any other window function that minimizes the distortion introduced by truncating the data. Those skilled in the art can readily identify an appropriate

5   window function.

Alternatively, the identification can be performed after a pre-determined amount of time of viewing, in which case the length of the window function is set accordingly.

In the present invention, the learning process or the

10   classification process can be reset to start a new learning or classification process. In one embodiment using Fourier transform and correlation to identify the subscriber, a reset function can be applied when the correlation measures between stored common identifiers 930 and new processed SSD

15   become relatively close.

As previously discussed, identifying an individual subscriber among a set of subscribers can be thought as finding a subscriber profile 150 whose common identifier is highly correlated with the processed selection data of the

20   actual viewing session.

FIG. 10 illustrates a pseudo-code that can be used to implement the identification process of the present invention. As illustrated in FIG. 10, the subscriber selection data 250 of a viewing session are recorded. The

25   subscriber selection can be a channel change sequence, a volume control sequence or a combination of both sequences. A Fourier transformation is applied to the sequence to obtain the frequency components of the sequence which is representative of the profile of the subscriber associated

30   with the viewing session. In a preferred embodiment, the Fourier transform F_T_SEQ is correlated with each of the N common identifiers stored in the system. As illustrated in FIG. 10, the maximum correlation value is determined and its

12.

argument is representative of the identifier of the subscriber profile 150.

Although this invention has been illustrated by reference to specific embodiments, it will be apparent to those skilled in the art that various changes and modifications may be made which clearly fall within the scope of the invention. In particular, the examples of a neural network and Fourier transform are not intended as a limitation. Other well known methods can also be used to implement the present invention A number of neural network, fuzzy logic systems and other equivalent systems can be utilized and are well known to those skilled in the art. Additional examples of such alternate systems for realizing neural network 400 are described in the text entitled "Neural Networks, a Comprehensive Foundation, " by Simon Haykin, and in "Understanding Neural Networks and Fuzzy Logic," by Stamatios V. Kartalopoulos, both of which are incorporated herein by reference.

The invention is intended to be protected broadly within the spirit and scope of the appended claims.

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Claims

What is claimed is:

1. In a data processing system, a method of identifying a subscriber comprising the steps of:

    (a)   monitoring a plurality of viewing sessions;

    (b)   clustering the viewing sessions wherein the sessions within a cluster have a common identifier representative of a subscriber selection data ; and

    (c)   identifying a subscriber from the clusters of viewing sessions based on the subscriber selection data.

2. The method of claim 1 wherein the monitoring step (a) further comprises the steps of:

    (i)   recording subscriber selection data for each viewing session; and

    (ii) generating a program characteristics and program demographic data from programs viewed for each viewing session.

3. The method of claim 1 wherein the clustering step (b) further comprises the steps of:

    (i)   generating a session data vector from the subscriber selection data, the program characteristics and program demographic data for each viewing session; and

    (ii) passing a plurality of session data vectors to a classification system to form clusters of session data vectors.

4. The method of claim 1 wherein the clustering step (b) further comprises the steps of:

14.

(i) generating a signature signal from the subscriber selection data for each viewing session;

(ii) generating a session profile from the subscriber selection data, the program characteristics and program demographic data for each viewing session and wherein the signature signal is the common identifier; and

(iii) passing a plurality of session profiles to a classification system to form clusters of session profiles.

5.   In an entertainment/information providing system, a method for identifying an individual subscriber from a set of subscribers, the method comprising the steps of:

(a)   recording subscriber selection data;

(b)   applying a signal processing algorithm to the subscriber selection data to form a processed version of the subscriber selection data; and

(c)   identifying the individual subscriber from the set of subscribers based on the correlation of the processed version of the subscriber selection data with common identifiers.

6.   The method of claim 5, wherein the subscriber selection data is a channel change sequence.

7.   The method of claim 5, wherein the subscriber selection data is a volume sequence.

8.   The method of claim 5, wherein the subscriber selection data is time-of-day viewing data.

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9. The method of claim 5, wherein the signal processing algorithm of step (b) is a Fourier transform based algorithm.

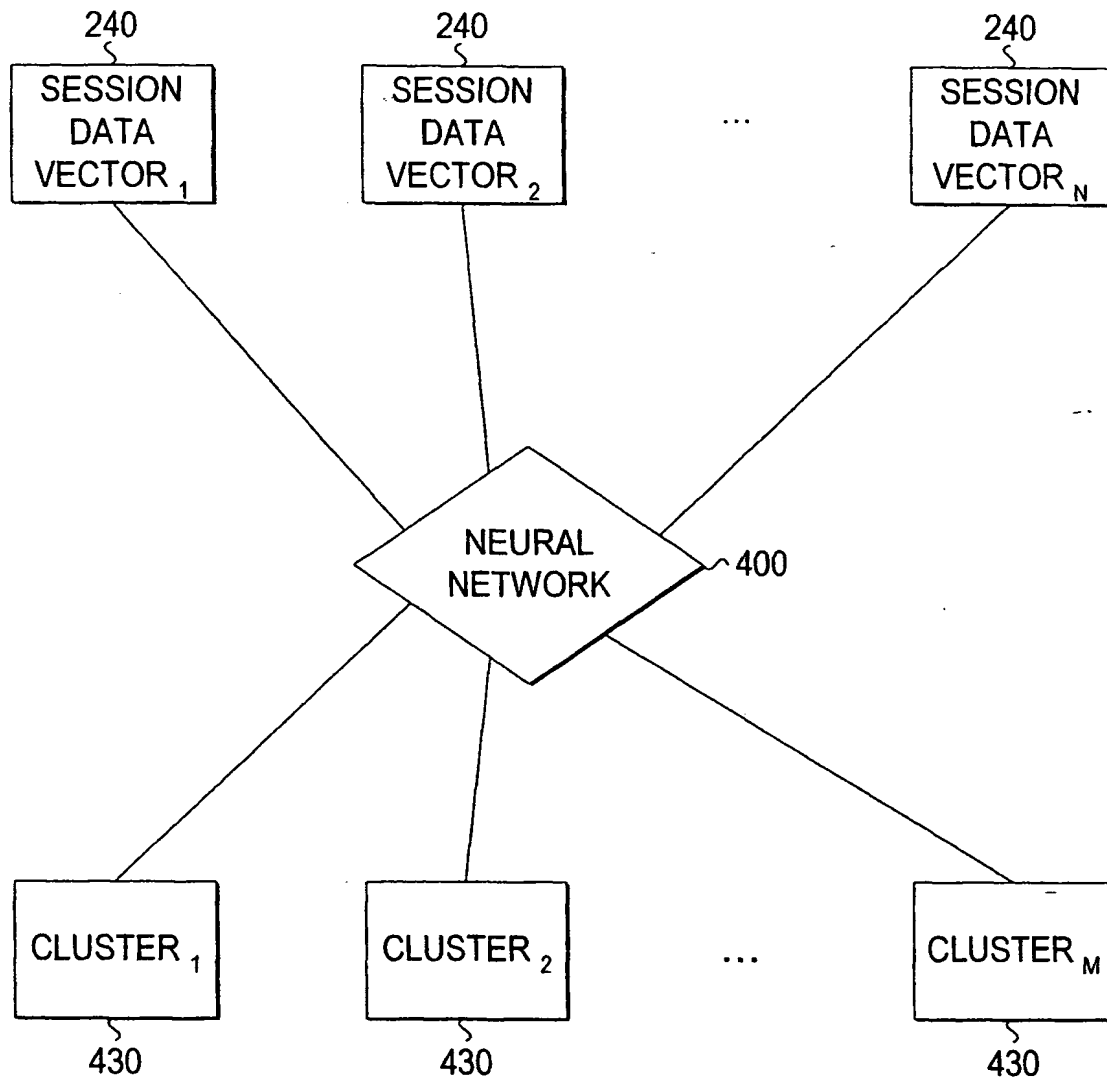10. A computer program embodied on a computer-readable medium for identifying an individual subscriber from a set of subscribers, said computer program comprising:

   (a) a subscriber selection code segment for recording subscriber selection data;

   (b) a signal processing code segment for processing the subscriber selection data and for producing a processed version of the subscriber selection data;

   (c) an identifying code segment for identifying the individual subscriber from the set of subscribers based on the correlation of the processed version of the subscriber selection data with common identifiers.

11. The computer program of claim 10, wherein the subscriber selection data is a channel change sequence.

12. The computer program of claim 10, wherein the subscriber selection data is a volume sequence.

13. The computer program of claim 10, wherein the subscriber selection data is time-of-day viewing data.

14. The computer program of claim 10, wherein the signal processing algorithm of step (b) is a Fourier transform based algorithm.
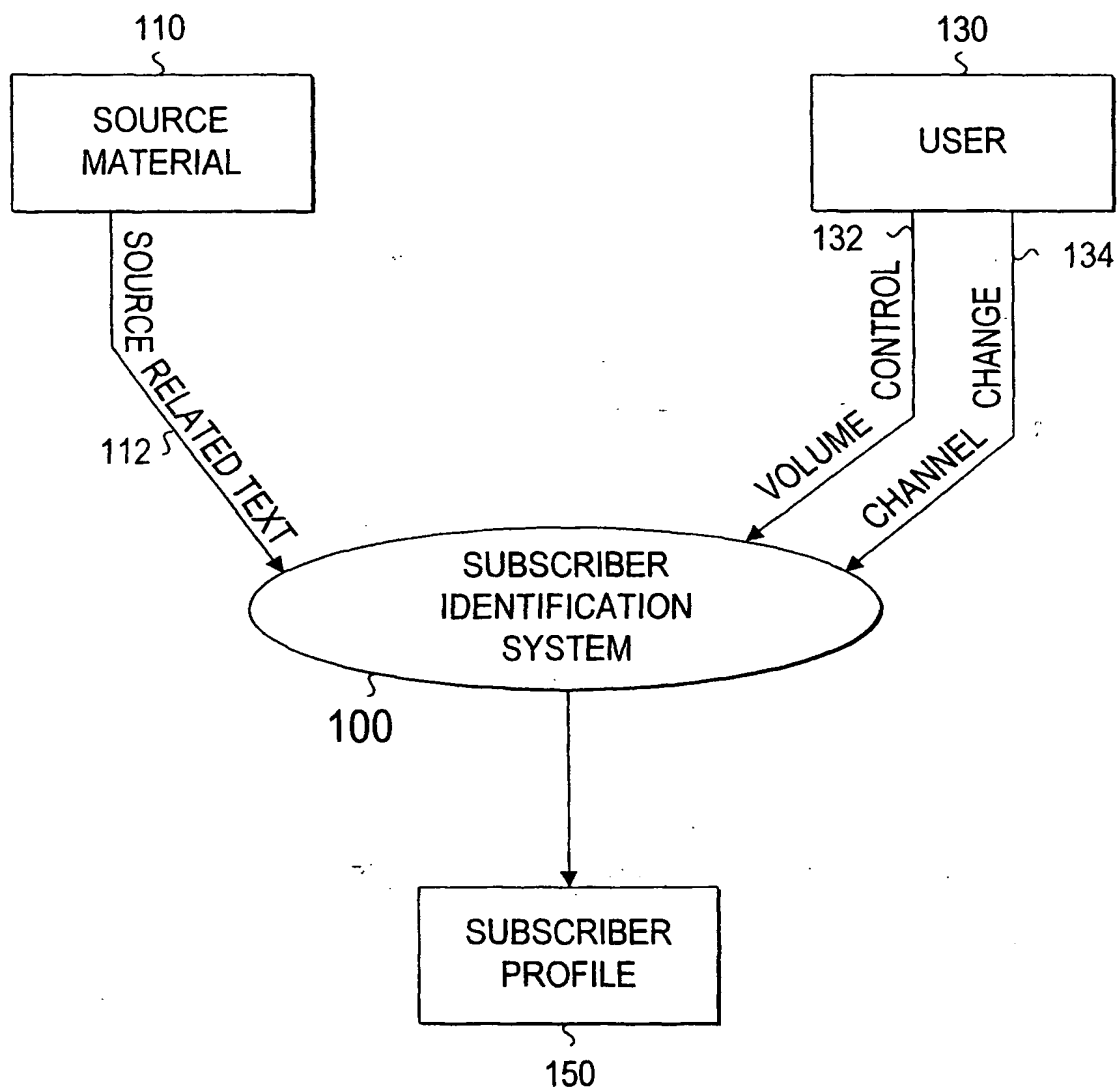
FIG. 1
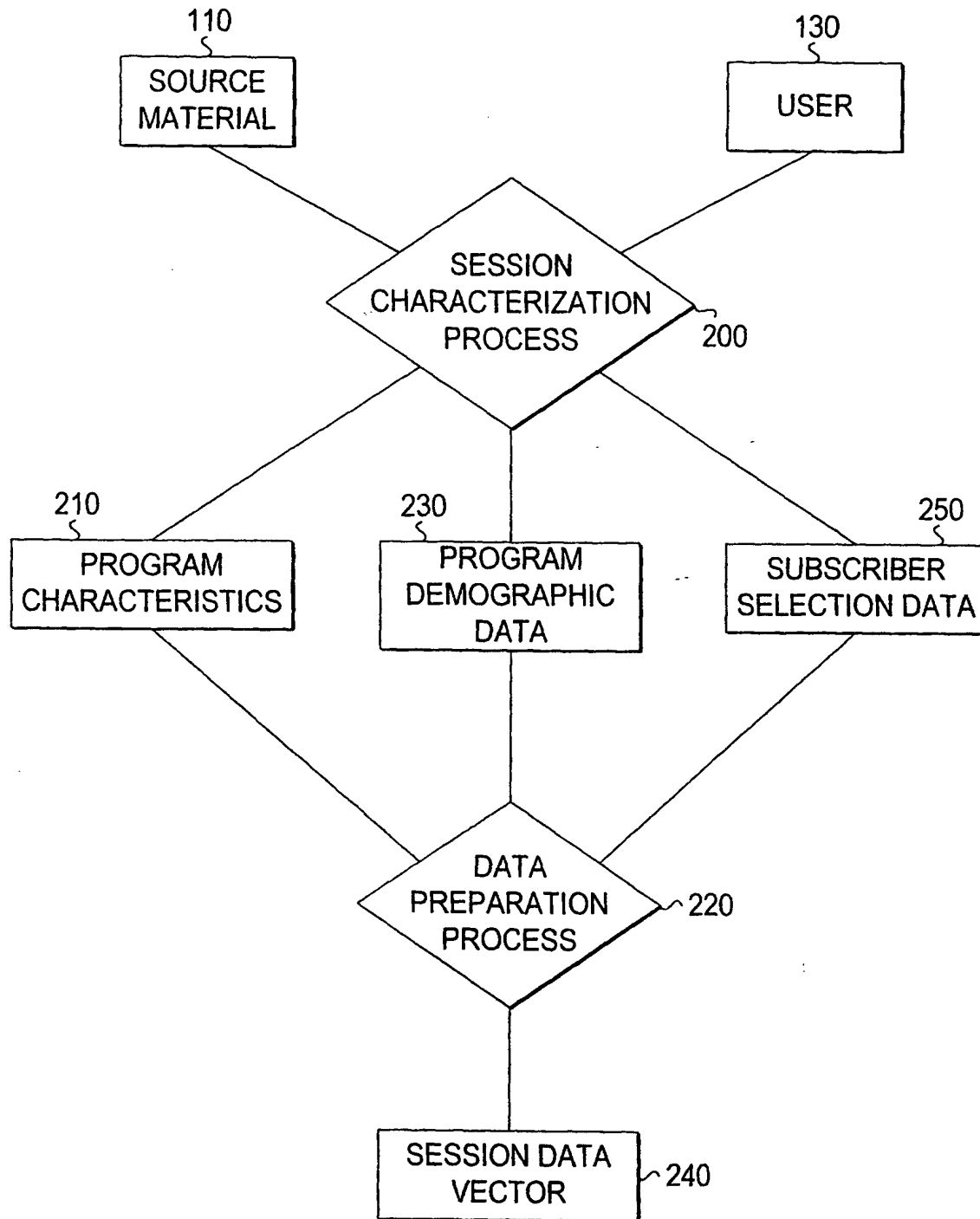
FIG. 2

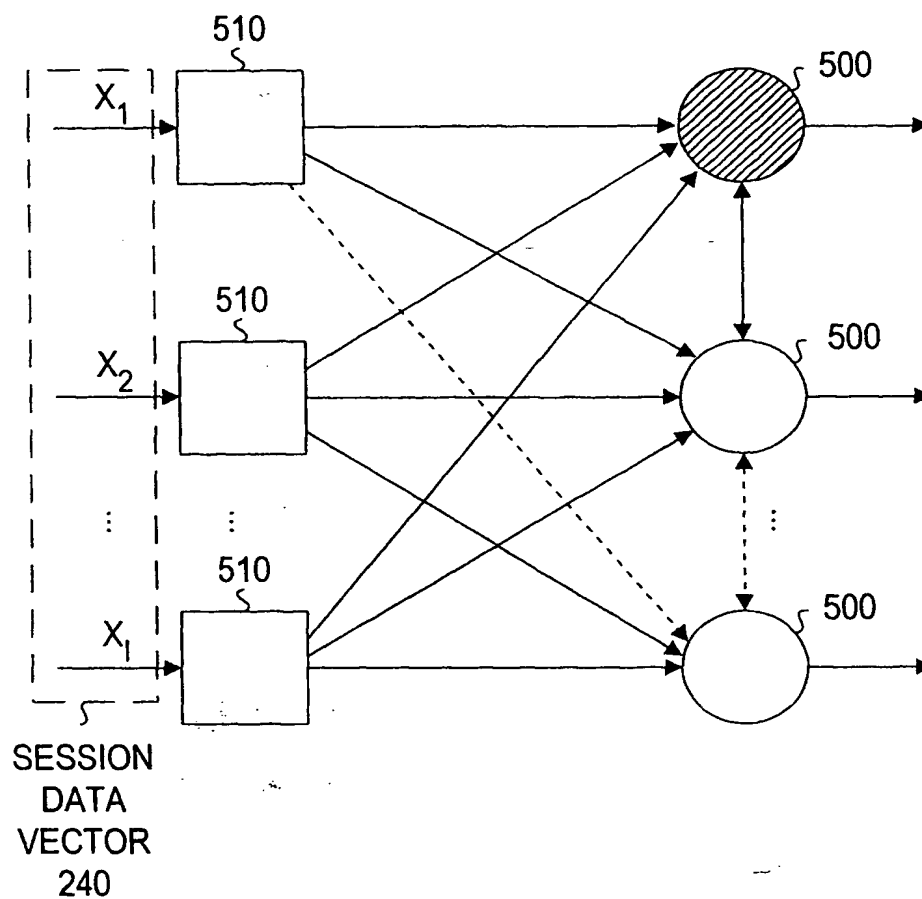|		SESSION VALUE
CATEGORY	CATEGORY 1	1
	CATEGORY 2	0
	⋮	⋮
	CATEGORY K	1
SUB-CATEGORY	SUB-CATEGORY 1	1
	SUB-CATEGORY 2	0
	⋮	⋮
	SUB-CATEGORY L	0
CONTENT	CONTENT 1	1
	CONTENT 2	1
	⋮	⋮
	CONTENT P	0
PROGRAM TITLE	PROGRAM TITLE 1	1
	PROGRAM TITLE 2	0
	⋮	⋮
	PROGRAM TITLE Q	0
CHANNEL CHANGE	1ST MINUTE	2
	2ND MINUTE	2
	⋮	⋮
	10TH MINUTE	0
VOLUME LEVEL	MUTE	0
	1-4	0
	5-7	1
	8-10	0
AGE	4-10	0
	11-14	1
	⋮	⋮
GENDER	M	0
	F	1

FIG. 3

FIG. 4

FIG. 5
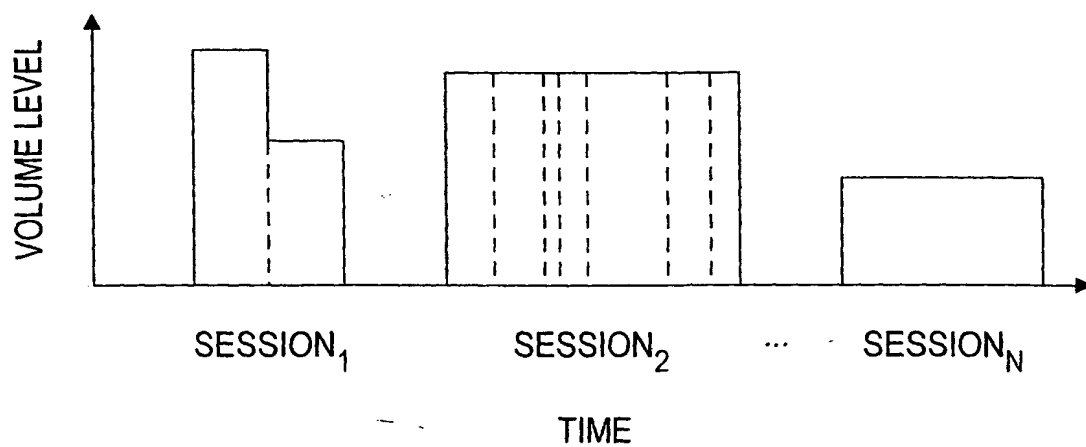
FIG. 6A
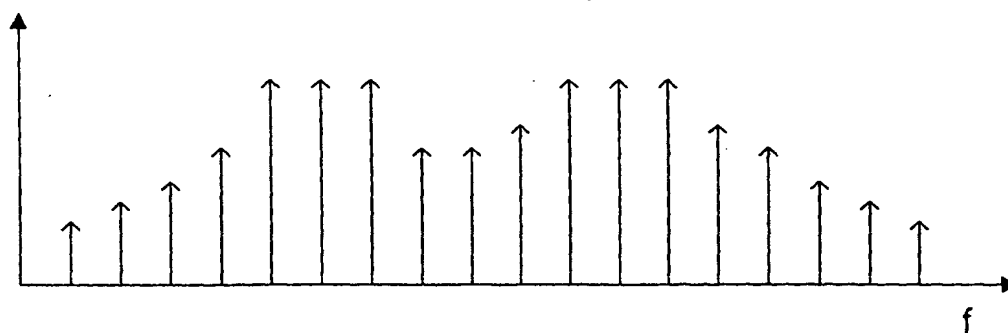
FIG. 6B
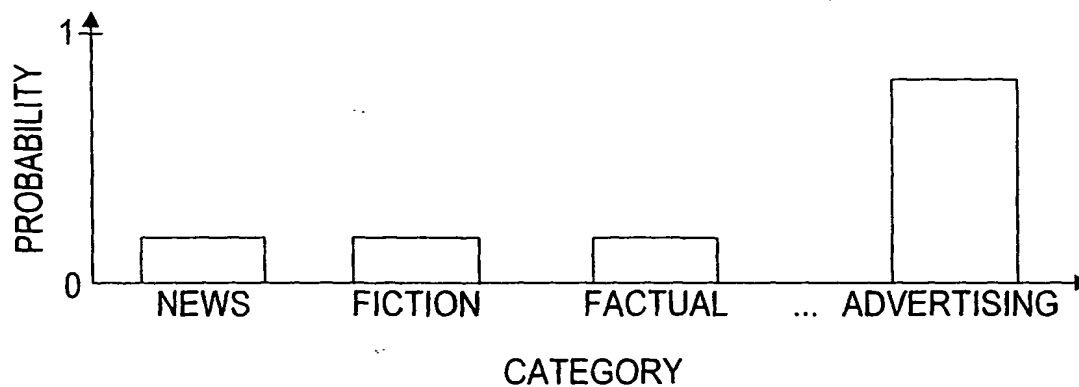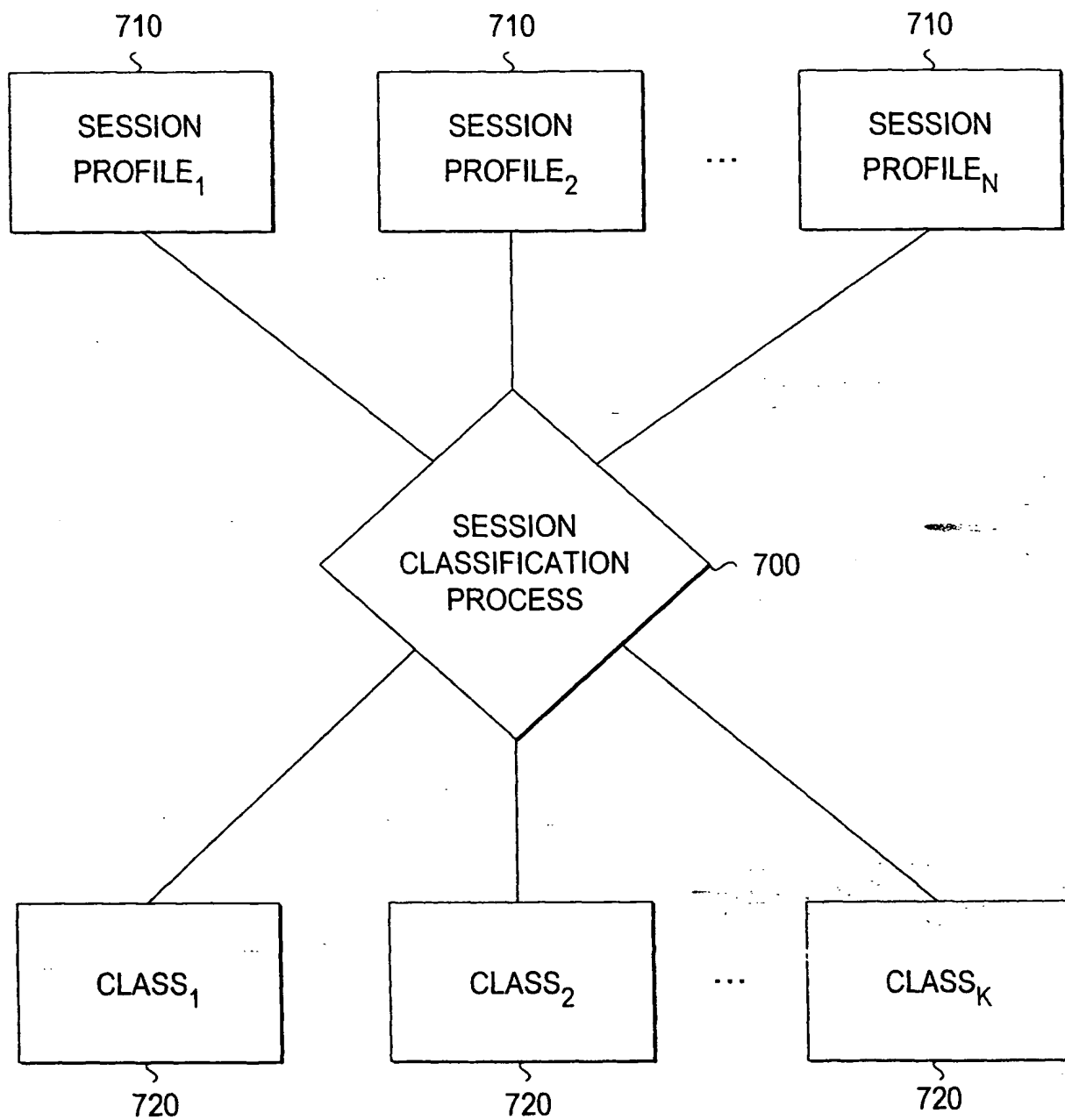
FIG. 6C
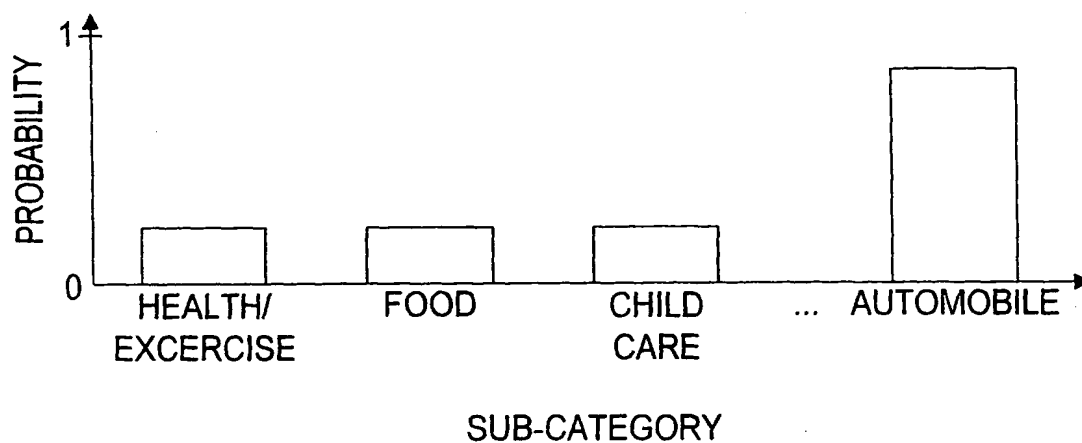
FIG. 6D
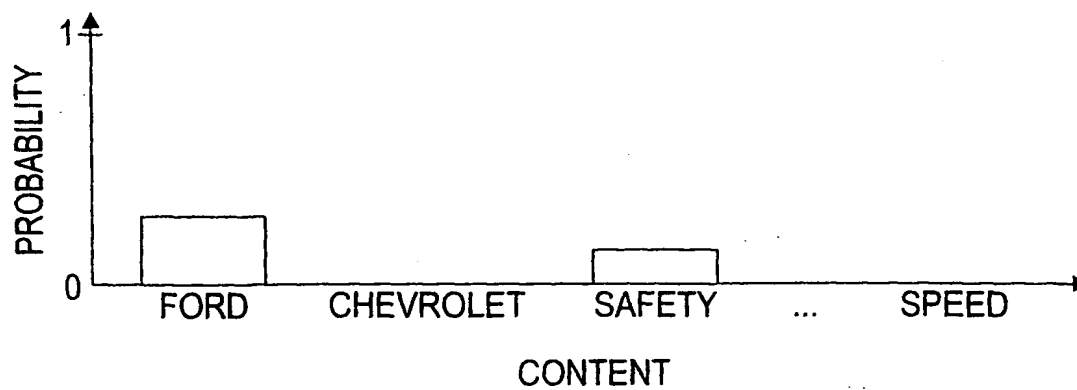
FIG. 6E
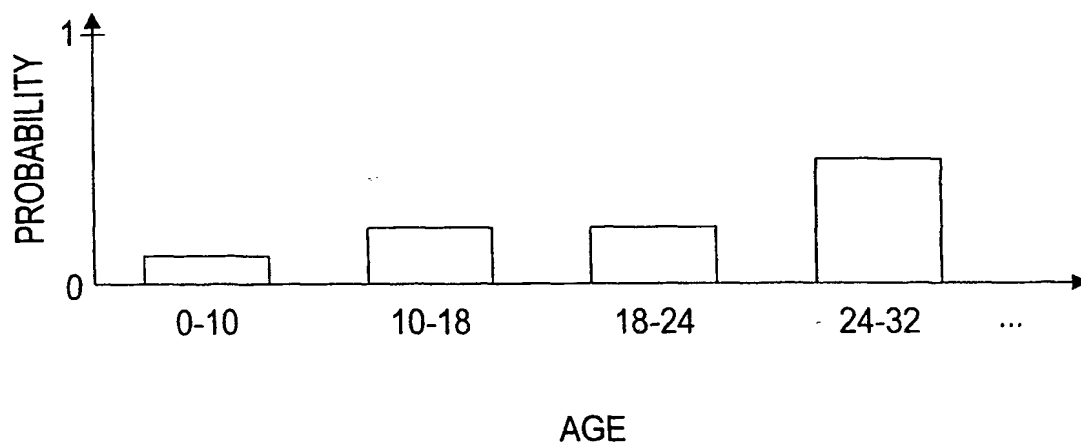
FIG. 6F
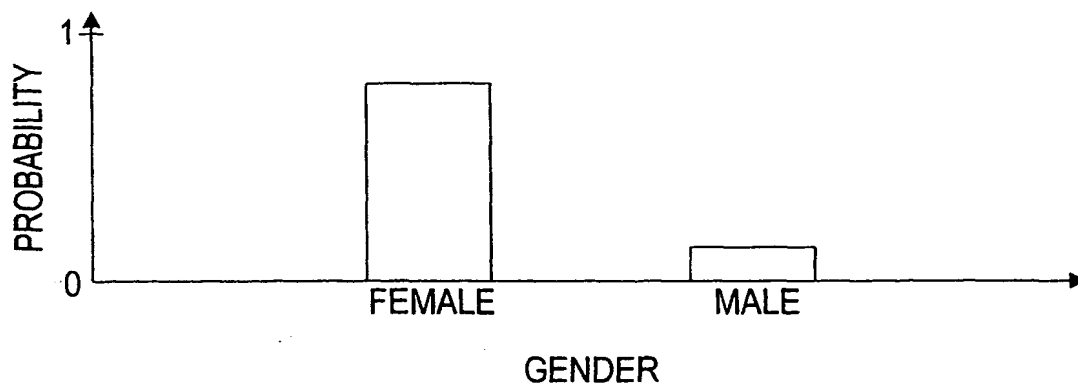
FIG. 6G

FIG. 7

IF PROB (GENDER = FEMALE) ≥ 0.7 AND PROB (CATEGORY=SOAP OPERA) ≥ 0.7

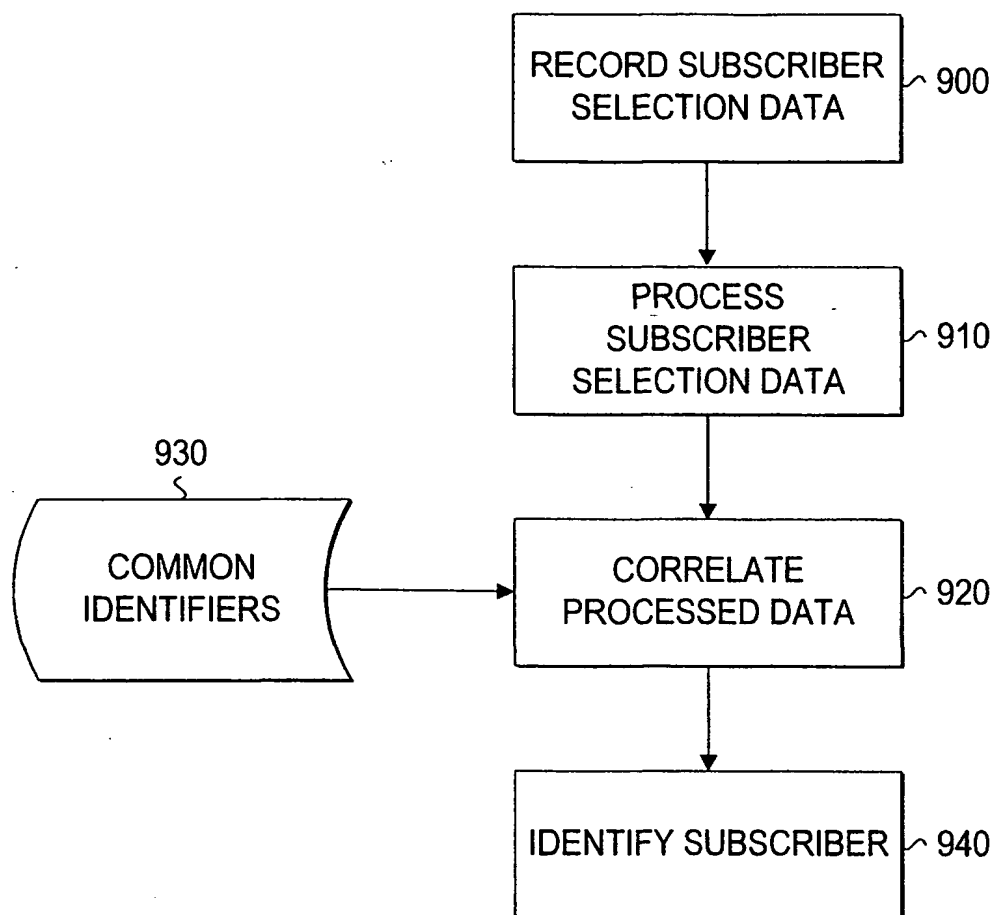   SET   GENDER = FEMALE

IF PROB (GENDER = MALE) ≥ 0.7 AND PROB (CATEGORY = SPORT) ≥ 0.7

      SET   GENDER = MALE

FIG. 8

FIG. 9

RECORD [SEQUENCE]; /* STORE SUBSCRIBER SELECTION DATA I.E.
                      CHANNEL CHANGE AND VOLUME CHANGE */

F_T_SEQ= FOURIER [SEQUENCE]; /* COMPUTE FOURIER TRANSFORM OF
                                SEQUENCE */

FOR I = 1 TO N
        BEGIN
                COR_VAL(I)= CORRELATE [F_T_SEQ, COM_IDENT (I)];
                        /* COM_IDENT (I) REPRESENTS THE COMMON
                           IDENTIFIER OF THE ITH SUBSCRIBER PROFILE */

                STORE COR_VAL (I);
        END

SUB_ID = ARG $\left\{ \underset{I}{MAX} (COR\_VAL\ (I)) \right\}$;

        /* SUBSCRIBER W/ MAX CORRELATION VALUE W/ F_T_SEQ IS
           IDENTIFIED */

FIG. 10

INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) :G06F 151/00

US CL :Please See Extra Sheet.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 705/1, 10, 14

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

Please See Extra Sheet.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,155,591 A (WACHOB) 13 October 1992, col. 4, lines -col. 6, lines 1-68.	1-14
Y	US 4,779,198 A (LURIE) 18 October 1988, col. 3, lines 9-19, col. 10, lines 66-, col. 11, lines 1-11.	1-14
A,E	US 6,035,280 A (CHRISTENSEN) 07 March 2000, Figures 1-14.	1-14
A	US 4,833,30 A (HUMBLE) 23 May 1989, col. 2, line 15-, col. 3, lines 1-68.	1-14

☐ Further documents are listed in the continuation of Box C.   ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance		
"E"	earlier document published on or after the international filing date	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed	"&"	document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
25 MARCH 2000	2 5 APR 2000

| Name and mailing address of the ISA/US
Commissioner of Patents and Trademarks
Box PCT
Washington, D.C. 20231
Facsimile No. (703) 305-3230 | Authorized officer
TODD VOELTZ   Joni Hill
Telephone No. (703) 305-9714 |

Form PCT/ISA/210 (second sheet) (July 1998)★

A. CLASSIFICATION OF SUBJECT MATTER:
US CL :

705/1, 10, 14

B. FIELDS SEARCHED
Electronic data bases consulted (Name of data base and where practicable terms used):

APS
profile,demographic,age,gender,sex,characteristics,user,viewers,litseners,users,consumers,sub
scribers,determines,probability,guess